DR-12. EFFECT OF COPPER DOPING ON LUMINESCENT CHARACTERISTICS OF HYDROCHEMICAL DEPOSITED ZnS THIN FILMS

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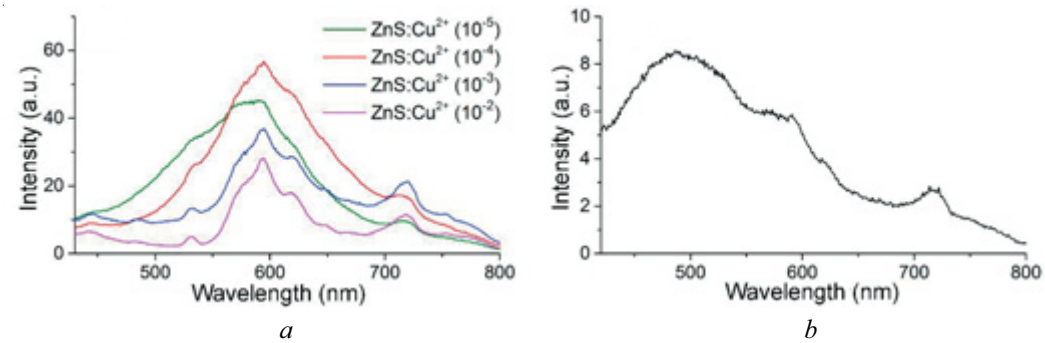
The ZnS semiconductor is widely used in electroluminescent light sources, UV and X-ray sensors and different biomedical applications. The luminescence properties of ZnS may be improved by means of doping and/or variation of synthesis parameters. In this work the chemical bath deposition method (CBD), being the simple, cost effective and not requiring sophisticated instruments and the creation of high temperatures and pressures, was used for the preparation of ZnS:Cu thin films. Doping of ZnS films was carried out during synthesis from a reaction bath containing a zinc salt, ammonium hydroxide, thiourea and a copper salt with a concentration of 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} mol/l.

Photoluminescence spectra of ZnS : Cu thin films (Figure, *a*) and glass substrate (Figure, *b*) have been measured under 260 nm excitation. A slight emission of the substrate in the blue-green region of the spectrum is possible under these excitation parameters, the maximum is observed at 486 nm. The luminescence spectra of the films contain a broad intense band with a maximum at 595 nm, probably due to the luminescence of the Cu_2S impurities formed during the synthesis because of the lower value of the solubility product ($SP = 2{,}5 \cdot 10^{-48}$) as compared with ZnS ($SP = 1{,}6 \cdot 10^{-24}$). Two less intense peaks at 443 nm and 483 nm belong to the studied phase and are associated with the presence of sulfur (V_S) and zinc vacancies (V_{Zn}), respectively [1]. The luminescence in this spectral region is substantially suppressed in all samples, possibly due to the formation of impurity copper-containing phases. The band at 532 nm arises from recombination between the level of the donor (V_S) and the level of t_2 in Cu^{2+} [2]. The greatest contribution of the recombination process to the general form of the luminescence spectrum is observed for a composition with a minimum



a *b*

Photoluminescence spectra of ZnS : Cuthin films (*a*) and glass substrate (*b*)

copper content (10^{-5} mol/l). It can be argued that the most efficient energy transfer from the host (ZnS) to Cu^{2+} ions occurs at this concentration of dopant. A subsequent increase in the copper content leads to a gradual decrease in the intensity of the green component due to concentration quenching, as well as the formation of a copper (I) sulfide phase, which is not transparent to the radiation. The peak at 720 nm can be caused by both the luminescence of glass substrate and the presence of oxygen in the layers.

References

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